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PATENT
450110-03696

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Morgan William Amos DAVID et al.
Serial No.	:	10/016,828
Filed	:	December 4, 2001
For	:	IDENTIFYING, RECORDING AND REPRODUCING INFORMATION
Art Unit	:	2615

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Name of Applicant, Assignee or Registered Representative

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Date of Signature

CLAIM OF PRIORITY

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

In support of the claim of priority under 35. U.S.C. § 119 asserted in the Declaration accompanying the above-entitled application, as filed, please find enclosed herewith certified copies of U.K. Application Nos. 0008398.0 and 0008426.9 and 0008436.8, filed in U.K. on 5 April 2000 and 5 April 2000 and 5 April 2000, respectively, forming the basis for such claim.

Acknowledgment of the claim of priority and of the receipt of said certified copy(s) is requested.

Respectfully submitted,

FROMMER LAWRENCE & HAUG LLP
Attorneys for Applicants

By: _____
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Enclosure(s)

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-5 APR 2000

1. **Your reference** — P007527GB

5 APR 2000

2. **Patent application number** *(The Patent Office will fill in this part)* — **0008426.9**

06APR00 E527469-23 D02246
P01/7700 0.00-0008426.9

3. **Full name, address and postcode of the or of each applicant** *(underline all surnames)*

SONY UNITED KINGDOM LIMITED
THE HEIGHTS
BROOKLANDS
WEYBRIDGE, KT13 0XW

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — UNITED KINGDOM

4. **Title of the invention** — RECORDING/REPRODUCING APPARATUS AND METHOD FOR RECORDING/REPRODUCING INFORMATION SIGNALS

5. **Name of your agent** *(if you have one)* — D YOUNG & CO

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

21 NEW FETTER LANE
LONDON
EC4A 1DA

Patents ADP number *(if you have one)* — 59006

6. **If you are declaring priority from one or more earlier patent applications, give the country and date of filing of the or each of these earlier applications and (if you know it) the or each application number**

Country	Priority application number *(if you know it)*	Date of filing *(day/month/year)*

7. **If this application is divided or otherwise derived from an earlier UK application, give the number and filing date of the earlier application**

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Any other documents *(please specify)*	0

11. **I/We request the grant of a patent on the basis of this application.**

Signature for D Young & Co — **Date** 05 04 00

D YOUNG & CO
Agents for the Applicants

12. **Name and daytime telephone number of the person to contact in the United Kingdom**

DR J M DEVILE 023 8063 4816

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Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road
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1. Your reference — P007527GB

2. Patent application number *(if you know it)* — 0008426.9

3. Full name of the or of each applicant — SONY UNITED KINGDOM LIMITED

4. Title of the invention — RECORDING/REPRODUCING APPARATUS AND METHOD FOR RECORDING/REPRODUCING INFORMATION SIGNALS

5. State how the applicant*(s)* derived the right from the inventor*(s)* to be granted a patent — BY VIRTUE OF ASSIGNMENT DATED 12 APRIL 2000 BETWEEN OURSELVES AND THE OVERNAMED INVENTORS

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7. **I/We believe that the person*(s)* named over the page *(and on any extra copies of this forms)* is/are the inventor*(s)* of the invention which the above patent relates to.**

Signature — Date

for D Young & Co — 5 Jun 2000

D YOUNG & CO
Agents for the Applicants

8. Name and daytime telephone number of person to contact in the United Kingdom — 023 80634816 — Dr Jonathan DeVile

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D Young & Co ref: P007527GB

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

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RECORDING/REPRODUCING APPARATUS AND METHOD FOR RECORDING/REPRODUCING INFORMATION SIGNALS

Field of Invention

The present invention relates to recording apparatus and methods of recording audio and/or video information signals. More particularly the present invention relates to recording apparatus and methods of recording audio and/or video information signals onto a linear recording medium. Correspondingly, the present invention also relates to reproducing apparatus and methods of reproducing audio and/or video information signals and in particular information signals recorded onto a linear recording medium.

Background of the Invention

It is known to store audio and video information in a form in which the information may be reproduced when required. Typically this is effected by recording signals representative of the information onto suitable recording media in order to provide a reproducible record of the audio and video information signals. For example the conventional consumer video recorder is provided with an arrangement in which a rotating magnetic head records audio and video information signals in tracks on a magnetic tape. Similarly a hand held video camera or "camcorder" is provided with an arrangement for converting an image formed within a field of view of the camera into video signals which are recorded onto a magnetic tape along with accompanying audio signals. For professional video cameras the preferred medium for recording a reproducible record of the audio and video signals generated by the camera is to record the video signals onto a magnetic tape in some way. The foregoing examples all use magnetic tape to record information, however as will be appreciated magnetic tape is only one example of a linear recording medium in which information signals are recorded onto the medium in some way as the recording medium is driven past a recording head at a rate determined by the band width of the information signal being recorded and the capacity of the recording medium to represent these information signals.

There is a wide variety and a great number of audio and/or video productions which are generated by television companies, by domestic users as well as professional production companies. Sports programs, musical and opera productions, documentaries and light entertainment comedy programmes are but examples of this wide variety of audio and/or video productions. The term audio and/or video will be referred to herein as audio/video and includes any form of information representing sound or visual images or a combination of sound and visual images.

As a result of the rich variety and great number of audio/video productions in existence, the task of managing and navigating through an archive of audio/video productions in order to locate particular features or content items of audio/video material within an archive is considerably time consuming. Similarly editing an audio/video production typically represents a labour intensive task because the audio/video material must be visually scanned by the operator to locate a particular feature of interest. As a result it has been proposed in our co-pending UK patent application number GB 9921235.9 to provide an apparatus and a method for navigating through audio/video information signals using metadata.

The term metadata as used herein refers to and includes any form of information or data which serves to describe either the content of audio/video material or parameters present or used to generate the audio/video material or any other information associated with the audio/video material. Metadata may be, for example, "semantic metadata" which provides contextual/descriptive information about the actual content of the audio/video material. Examples of semantic metadata are the start of periods of dialogue, changes in a scene, introduction of new faces or face positions within a scene or any other items associated with the source content of the audio/video material. The metadata may also be syntactic metadata which is determined and associated with items of equipment or parameters which were used whilst generating the audio/video material such as for example an amount of zoom applied to a camera lens, an aperture and shutter speed setting of the lens, and a time and date when the audio/video material was generated. Although metadata may be recorded with the audio/video material with which it is associated, either on separate parts of a recording medium or on common parts of a recording medium, metadata in

the sense used herein is intended for use in navigating and identifying features and essence of the content of the audio/video material, and may, therefore be separated from the audio/video signals when the audio/video signals are reproduced. The metadata is therefore separable from the audio/video signals.

Summary of Invention

According to the present invention there is provided a recording apparatus which is arranged in operation to record audio and/or video information signals onto a linear recording medium, the apparatus comprising a recording drive arranged in operation to record the information signals onto the linear recording medium, and to record metadata associated with the information signals onto the linear recording media with the information signals, wherein the metadata is recorded repeatedly.

An improvement is provided to a recording apparatus which is arranged to record the metadata repeatedly with the audio/video information signals. This is because recording the same metadata repeatedly increases a probability that the metadata will be recovered correctly when the information signals are read from the linear recording medium despite any loss of information. A loss of information may occur as a result of errors produced in recording/reproducing the audio/video information and metadata. A loss of information may also occur when, for example, the linear recording medium is "shuttled" in which the linear recording medium is moved past the recording heads at a rate which is greater than the rate at which the information signals were recorded.

The metadata may comprise a plurality of objects and the recording apparatus may comprise a control processor coupled to the recording drive which is arranged in operation to determine a relative importance of the information represented by the metadata objects and configure the recording drive to record the metadata objects a number of times corresponding to the relative importance of the metadata objects.

As will be appreciated because there is a considerable variation in the type and content of metadata, different types of metadata will vary in value and therefore importance to the audio/video signals with which the metadata is associated. For example, a metadata type of high importance is the Unique Material Identifier (UMID) whereas metadata of low importance is for example the F-stop or aperture setting of

the camera which was used whilst the audio/video information signals were being generated. By recording the metadata repeatedly in accordance with the importance of the metadata, a greater immunity to the effect of errors and to any loss of information which may occur when the information signals and metadata are being reproduced from the linear recording medium is unequally provided, with the metadata of greater importance being provided with greater protection.

Dividing the metadata into metadata objects which define a type and therefore relative value of the metadata, provides an estimate of the relative importance of the metadata. This is effected by the control processor which also configures the recording drive to record the metadata objects a number of times determined in accordance with the relative importance of the metadata which the objects represent.

The recording drive may be arranged in operation to record the information signals onto the linear recording medium at a recording rate, and the number of times the metadata objects are repeated may be determined by the control processor from a combination of the relative importance and a reading rate at which the recorded information signals may be read from the linear recording medium.

When recording information signals on to a linear recording medium such as a magnetic tape, the information signals are arranged to be recorded on to the magnetic tape by driving the tape at a recording speed past a recording head which is excited by the information signals. The rate at which the tape is driven is determined in accordance with the bandwidth of the information signals, and the capacity of the recording medium to represent these signals. The rate at which the tape is driven when recording the information signals will be known herein as the recording rate. When the information signals are reproduced from the recording medium, the recording medium is again driven passed read heads which read the information signals from the magnetic tape. The rate of driving the recording medium passed the reading head is known herein as the reading rate and in order to recover all the information signals, the reading rate should be the same as the recording rate. However, in a mode known as "shuttle" mode, the reading rate may be increased so that although not all the information signals may be recovered from the recording medium an amount is recovered which is sufficient to provide a representation of the information signals for

fast searching. Thus, an effect of shuttle mode is to reduce an amount of information which is recovered from the linear recording medium. Therefore, by repeating the same metadata object in accordance with the relative importance of the metadata object, the more important metadata objects are more likely to be correctly recovered.

Furthermore the control processor may operate to determine the number of times the metadata objects are repeated from the relative importance and a number of times the reading rate is greater than the recording rate. The number of times the reading rate is greater than the recording rate provides an integer indication of the number of times the metadata object must be repeated in order for the metadata object to be recovered during shuttle mode.

In a preferred embodiment the recording drive may operate to record the information signals and the metadata on to the linear recording medium whereby the information signals and the metadata may be separated when read from the linear recording medium.

The control processor may be arranged in operation to assign each of the metadata objects to one of a plurality of categories of relative importance and to allocate each of the metadata objects to one of the categories of relative importance the number of times the metadata objects are repeat recorded being pre-determined for each of the categories.

An improvement is provided by arranging the metadata objects into a plurality of categories and repeat recording the metadata objects in accordance with the category. This provides a reproducing apparatus arranged in operation to reproduced the information signals with an implicit reference to the number of times the same metadata object has been recorded and therefore in dependence upon the reproducing rate the reproducing apparatus may determine whether the same metadata object has been read more than once. In this way, a probability of successfully recovering a metadata object may be increased by allocating the metadata object to a category which has a greater number of predetermined repetitions when recorded. Thus by assessing the relative importance, the more important information may be allocated to a category of higher importance and thereby this information is more likely to be recovered when the metadata and information signals are reproduced.

In a preferred embodiment, for each of the categories of relative importance the control processor may be arranged in operation to record the same allocated metadata object in each of a plurality of adjacent cells of the recording medium for the predetermined number of times and record a subsequent metadata object allocated to the same category for the predetermined number of times in a corresponding plurality of adjacent cells. Furthermore the same metadata object may be recorded with reference to a temporal marker recorded with the information signals and the metadata objects. In this way when the reproducing apparatus is recovering the metadata objects, a plurality of cells may be read from the linear recording medium and with reference to temporal marker the reproducing apparatus may determine whether the same metadata object has been recovered.

As an alternative arrangement for repeat recording metadata objects onto the linear recording medium the control processor may be arranged in operation to form metadata packets having a plurality of fields, and to control the recording drive to record the metadata packets on to the linear recording medium, whereby the metadata objects are repeated the pre-determined number of times.

Arranging the metadata objects into packets provides a predefined unit which may contain different metadata objects or the same metadata objects which can be recorded in a controlled way so that recovery of the metadata objects may be facilitated.

The control processor may allocate the metadata objects to the fields of the packets, whereby the metadata object is repeated in the fields of at least one of the packets.

Furthermore the control processor may be arranged in operation to allocate a different metadata object to at least two of the fields of the packet and record repeatedly the metadata packet the predetermined number of times. By providing the packet with different metadata objects and recording the metadata packet the determined number of times for the relative importance of the metadata objects, the relative protection provided by the repeat recording is effected for each of the different fields within the metadata packet.

The control processor may be arranged in operation to provide each of the metadata packets with a header field and to allocate header information to the header field which is indicative of the metadata objects within the fields of the packet.

Providing the metadata packets with a header which contains information which represents the content of the fields of the packets, facilitates identification of the metadata packets and recovery of the metadata objects from packets which have been repeatedly recorded.

The control processor may be arranged in operation to change the header information between successive packets recorded repeatedly onto the linear recording medium which have different metadata objects.

Changing the header information between successive packets which have different metadata objects provides a simple and convenient way of recognising where metadata packets which are repeatedly recorded change from one group to another. By detecting the change in the header information a reproducing apparatus may determine whether the metadata packets recovered from the recording medium contain more than one metadata packet which is the same. The reproducing apparatus may therefore discard redundant metadata packets which are those which are recovered after a first metadata packet of any one type has been recovered.

In a preferred embodiment the linear recording medium is a magnetic tape and the recording drive has a rotating head which is configured in operation to record the information signals in helical scan tracks disposed at an angle to a linear axis of the recording tape and a linear recording head which is configured in operation to record the metadata along the linear tracks of the magnetic tape at a position adjacent to the helical scan tracks. In preferred embodiments the linear tracks are allocated to the user specified bits and the time code allocated to the information signals.

According to an aspect of the present invention there is provided a reproducing apparatus which is arranged in operation to recover audio and/or video information signals recorded with metadata associated with the information signals onto a linear recording medium using a recording apparatus as herein before described, the reproducing apparatus comprising a reading drive which operates to recover the information signals from the linear recording medium and the metadata from the linear

recording medium and a read control processor which is arranged in operation to determine whether the same metadata has been read by the reading drive from the linear recording medium, to discard the metadata which has been read more than once and to reproduce the information signals with the metadata.

According to a second aspect of the present invention there is provided a method of recording audio and/or video information signals onto a linear recording medium comprising the steps of recording the information signals onto the linear recording medium, recording metadata associated with the information signals onto the linear recording medium with the information signals, wherein the metadata is recorded repeatedly.

Further aspects and features of the present invention are defined in the appended claims.

Brief Description of the Drawings

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings wherein:

Figure 1 is a schematic block diagram of a video camera,

Figure 2 is a schematic block diagram of part of the video camera shown in figure 1 which includes a recording apparatus,

Figure 3A is a schematic block plan view of recording heads arranged to record information onto the magnetic tape within the recording apparatus shown in figure 2, and

Figure 3B is an elevation view of the plan view shown in figure 3A,

Figure 4 is a schematic representation of a position and layout of information recorded onto a magnetic recording tape shown in figure 3,

Figure 5A is a representation of the magnetic recording tape shown in figure 4 read at twice the recording speed,

Figure 5B is a representation of the magnetic tape shown in figure 4 read at four times the recording speed, and

Figure 5C is a representation of the magnetic tape shown in figure 4 read at eight times the recording speed,

Figure 6 is an illustration of a process in which metadata objects are formed into a metadata packet,

Figure 7 is a representation of an arrangement of metadata objects recorded onto the magnetic recording tape,

Figure 8 is a representation of a further arrangement of metadata objects recorded onto the magnetic recording tape,

Figure 9 is a flow diagram representing a method for producing the arrangement of metadata objects represented in Figure 7, and

Figure 10 is a flow diagram representing a method for producing the arrangement of metadata objects represented in Figure 8.

Description of Preferred Embodiments

As indicated in the explanation above, there are a variety of apparatus in which audio/video information signals are recorded onto a linear recording medium. To illustrate example embodiments of the present invention, a video camera will be used as an example of such an apparatus. However as will be appreciated there are other examples of recording apparatus which could be used and in which information signals are recorded onto a linear recording medium.

An illustration of a video camera is shown in figure 1. In figure 1 the video camera is shown to comprise a lens arrangement 1 connected to a camera body 2. Also connected to the camera body 2 is a control unit 4 and a view finder 6. Also forming part of the camera is a microphone 8 which is coupled to a sound processor 10. The video camera operates to generate video signals representative of images falling on an image sensor 12. The lens arrangement 1 operates to focus images falling within the field of view of the lens arrangement 1 onto the image sensor 12. The image sensor 12 is connected to a video processor 14. The sound processor 10 and the video processor 14 feed audio and video signals respectively to a recorder 16. The recorder 16 operates to record the audio/video signals onto a magnetic tape which is loaded into the video camera, although this is not shown in figure 1. The video camera body 2 is also shown to include a metadata generation processor 20 which is connected to the recorder 16 by a connecting channel 22. The video and audio signals are received by the recorder 16 via two further connecting channels 24, 26. A better understanding of the operation of

the recorder 16 which is also arranged to reproduce recorded audio and video signals may be gathered from a more detailed block diagram of the body 2 of the video camera, which shows the recorder 16 and the metadata generation processor 20 where parts also appearing in figure 1 bear identical numerical designations.

In figure 2 the recorder 16 is shown to include a tape drive 30 having a drive head arrangement 32 which is configured to convert audio and video signals as well as metadata into a form in which they can be recorded onto a magnetic tape 34. Signals representative of metadata are produced by a read/write control processor 36 which is coupled to the drive head 32 via a connecting channel 38. To provide the read/write control processor 36 with a temporal reference, a frame clock 40 is connected to a first input 42 of the control processor 36. The read/write control processor 36 also receives from an external channel 44 signals representative of externally generated metadata. At a third input 48 the read/write control processor 36 receives signals representative of internally generated metadata from the metadata generation processor 20. The control processor 36 is also provided with a data store 50 which is coupled to the control processor 36 via a bi-directional connecting channel 52. The metadata generation processor 20 is shown in figure 2 to receive an input from a clock 54 and three further input sensors 56, 58, 60. The clock 54 provides the metadata generation processor with a temporal reference at which the video and audio signals generated by the audio processor and the video processor 10, 14 respectively are produced. The three sensors 56, 58, 60 serve to generate different signals representative of values of parameters of the camera which were use to capture the audio and video signals. For example the sensor 56 could provide signals representative of the "F=stop" or aperture setting of the lens arrangement 1 whereas the second sensor 56 could provide an indication of a frame rate of the video camera. The third sensor 60 could provide an indication of a "good shot marker" which is manually set by the operator of the camera when a good image or shot has been recorded by the camera.

The read/write control processor 36 is arranged in operation to control the tape drive 30 so that the audio and video signals are recorded onto the magnetic tape 34. However according to the example embodiment of the present invention the read/write

control processor 36 also operates to record metadata associated with the audio/video signals onto the magnetic tape 34.

In order to better appreciate and understand the example embodiments of the present invention a brief description and explanation will be given of the way in which audio/video signals are recorded onto the magnetic tape 34 along with a time code and an amount of storage capacity allocated to user specified bits. The user specified bits are an example of an information field which is available to the user and which can be used to for example record metadata. To this end figure 3 provides an illustration of an arrangement of read/write heads 33 which form part of the drive heads 32 in more detail. In figure 3A the drive heads 32 are shown to include a rotating head 70 and a linear head 72. Figure 3A shows the tape read/write heads 33 as a plan view so that the linear recording head 72 is represented as being below the rotating head 70. As shown in figure 3A the magnetic recording tape 34 is wrapped in the shape of the letter omega (Ω) around the rotating head. In this way the magnetic tape is fed past the rotating head 70 and the linear head 72 by the tape drive 30 at a rate which is determined by the band width of the video and audio signals being recorded and properties of the magnetic tape to represent this band width. As already indicated, the rate at which the tape is driven during recording is the recording rate. Figure 3B shows an elevation view of the read/write heads 33 and as confirmed in this view the linear recording head is disposed underneath the rotating head 70.

The operation of the read/write heads 33 will now be explained with reference to figure 4 in which the magnetic tape 34 is shown with areas 76, 78 of the tape shown where information has been recorded. In figure 4 the magnetic tape 34 is shown to have recorded on the surface a plurality of helical scan tracks 76 which are disposed at an angle to the linear access at which the magnetic tape is moved past the read/write heads 32. The direction of movement and the linear axis of the magnetic tape are indicated by the arrow 74. In figure 4 the helical scan tracks 76 are formed by the rotating head 70 which operates to record the audio and video signals in the helical scan tracks which are arranged at an angle to the linear access of the magnetic tape 34 so that the band width of the video and audio signals can be accommodated within the band width which the properties of the magnetic tape can accommodate. Also shown

in figure 4 are further areas below the helical scan tracks 76 which are representative of the areas on the magnetic tape where the linear head 72 records the user specified bits (USB) which also include a time code (TC). These linear tracks 78 which are recorded along the linear access of the magnetic tape 34. This is because the band width allocated to the USB and TC information is considerably less than that of the video and audio signals.

As will be appreciated by those skilled in the art, the read/write heads 33 can function both to record the video and audio information signals onto the magnetic tape 34 in the helical scan tracks 76 as well as the USB and TC information in the linear tracks 78 and correspondingly to read or reproduce the information recorded into the magnetic tape 34. When reproducing information recorded onto a magnetic tape it is often necessary to scan or fast forward through the audio and video information in order to navigate through the content of the audio and video information signals. As explained above, this is also know by the term 'shuttle' mode reproduction. In this mode although the rotating head 70 is arranged to rotate at the same speed as that when audio and video information signals were recorded onto the magnetic tape 34 so that the head follows the helical scan tracks at the angle at which the tracks were created with respect to the linear axis of the magnetic tape, during shuttle mode the magnetic tape is driven by the tape drive at a greater speed. As a result the rotating head passes over more than one helical scan track, the number of tracks that the rotating read head passes during any one rotation being determined by the amount by which the rate of feeding the linear tape during the reading rate is greater than the recording rate when the information was recorded. This is illustrated in figure 5A.

In figure 5A the magnetic tape 34 shown in figure 4 is shown to include designated areas shown as bold boxes 80 in figure 5A which are representative of the area of the magnetic tape from which information can be recovered by the rotating head 70 at a particular time. In figure 5A the arrow 74 which is representative of the rate at which the magnetic tape is fed past the read/write heads 70, 72 is shown to be twice that of the recording rate shown in figure 4 which is represented by a reference "x2". As shown in figure 5A, a result of the increase in speed of the magnetic tape is that instead of the reproduction area 80 following the linear tracks 76, the reproduction

area 80 moves from the bottom of one track to the top of the subsequent track. This is represented by the arrow 82. Correspondingly, a further reproduction area of the linear recording heads 72 is represented as a second bold box 84. Since the rotating head 70 and the linear recording head 72 are stationary and have a fixed relationship with respect to one another, the second reproduction area 84 which is representative of the area on the tape from which the linear read head 72 can recover information moves in correspondence with that of the first reproduction area 80. Therefore correspondingly with the times two (x2) speed up shown in figure 5A, the amount of information which can be recovered from the linear tracks 78 is correspondingly reduced because conventionally the information is recovered at normal read speed. As such, although there would be no loss of information from the linear recording track at up to thirty to forty times shuttle speed, conventionally a data processor executing software is provided to read the data recovered from the linear recording track. The data processor would loose information at a rate of twice shuttle speed (x2) because the data processor is arranged to recover data read from the linear recording track at, for example, normal reading rate. As a result information from these areas will be lost. Thus a reduced amount of the USB will be recovered from the magnetic tape 34.

Figures 5B and 5C reproduce the representation shown in figure 5A except that figure 5B shows a times four x4 speed up and figure 5C shows a times eight x8 speed up. As will be appreciated the amount of information which can be recovered in the times four and times eight speed ups shown by figures 5B and 5C will be proportionally reduced and this is indicated by the reproduction areas 80 shown at three positions as the rotating head moves at the same rate as was used to record the information.

Returning to figure 2 the operation of example embodiments of the present invention will now be explained. As will be appreciated from the foregoing discussion during shuttle mode the amount of USB information which may be recovered from the magnetic tape by the recorder 16 will be reduced in proportion to the amount by which the reading rate at which the magnetic tape is being shuttled past the read/write heads which is greater than the recording rate at which the magnetic tape was driven past the read/write heads when the information signals and USB were recorded onto the

magnetic tape 34. The read/write control processor 36 is arranged in operation to write the metadata fed from the external connecting channel 46 and the metadata generation processor 20 via the connecting channel 48 onto the magnetic tape in the areas which are designated for the USB information. In general the write control processor 36 operates to write repeatedly metadata onto the magnetic tape 34 in the USB areas 78 the number times the metadata is repeated being determined by the relative importance of the metadata.

As already explained there are various type of metadata which vary in their value and importance. For example a UMID would be of considerably higher value than the aperture setting or 'F-stop' value of the camera when the video signals were generated. Therefore by recording the more important metadata more often onto the magnetic tape than the less important metadata, an inherent increase in a probability of correctly recovering and reproducing the more important metadata will be produced.

According to a first embodiment of the present invention the read/write control processor 36 receives the metadata from the connecting channels 46, 48 and identifies the metadata as being associated with a predetermined different number of metadata types. The type may be for example the UMID, 'F-stop', time or location. This metadata is formed into metadata objects which may consist of a defined number of bytes or a single byte of metadata of the predetermined type. As shown in figure 6 according to the first embodiment of the present invention the read/write control processor 36 operates, after identifying the metadata objects, to form the metadata objects into packets. In figure 6 boxes 90 represent metadata objects which are different. The metadata objects are fed to a packet forming processor 92 which operates within the read/write control processor 36. The packet forming processor 92 then generates a metadata packet 94 by combining selected ones of the metadata objects and writing the metadata objects 90 into respective fields 96, 98, 100, 102 of the metadata packet 94. The read/write control processor 36 then generates header information which is written to a header 104 of the metadata packet 94.

Figure 7 provides a representation of an arrangement of metadata objects of the read/write control processor 36 when operating in accordance with the first embodiment of the present invention. The representation shown in Figure 7 is an

illustration of the arrangement in which metadata is repeatedly recorded and does not represent the physical layout of metadata as recorded onto the magnetic tape 34. The representation provided in figure 7 is therefore a conceptual form of one example of the first embodiment of the present invention which facilitates understanding. In figure 7 a plurality of metadata packets 94 are represented as columns within a matrix in which the rows each represent different fields of the metadata packet. In a preferred embodiment, each of the cells of the matrix represents a byte which is written onto the USB areas of the magnetic tape by the read/write heads 32 under control of the read/write control processor 36. As shown in figure 7 the metadata objects which form the second, third and fourth rows of the first four columns have the same values. These values represent, as an illustration, the letters of the word RED, each letter representing a different metadata object so that each letter is repeated four times. This is in accordance with the relative importance of this information. In the next four columns, the first three letters of the word GREEN are repeat recorded in the fields of these four metadata packets. As will be seen however in figure 7 the header information has changed from the first four to the subsequent four metadata packets in order to indicate to a reproducing apparatus that the metadata packets have changed. This is because during a shuttle mode in which for example the reading rate is two times that of the recording rate x2, two out of four metadata packets will be recovered. In this case, in order to provide a reproducing apparatus with a means for distinguishing different metadata packets from each other or to identify the same metadata packets which has been repeat recorded and recovered from the magnetic tape, the header information is provided. Thus as shown in figure 7 the header information is arranged to be different between different metadata packets which are successively recorded onto the magnetic tape. For the metadata objects which make up the words RED and GREEN, the headers are the numbers '0' and '1' respectively. As shown in figure 7 the third group of four repeated metadata packets 108 has a further different header information and in this case is given the number '2'. The fields of theses metadata packets include the last two letters of the word GREEN. The subsequent fourth group of four metadata packets are shown each to have a different value in the information header which are represented as numbers '0', '1', '2' and '3'.

The fourth group of metadata packets 110 represent metadata which is of relatively low importance compared to the words GREEN and RED recorded in the earlier metadata packets. As such in the fourth group of metadata packets, the metadata objects are recorded only once within the fields of the metadata packet. The information represented in the fourth group of metadata packets 110 is the date 01.11.99 and the time 13:28. Again the header information indicates that each of the metadata packets in the fourth group 110 contains different metadata objects. As will be appreciated by comparing the recording arrangement represented by the matrix shown in figure 7, a reproducing apparatus will be able to recover the most important metadata represented by the words RED and GREEN provided the rate of reading the magnetic tape during a shuttle mode is not greater than times four.

In order to recover the metadata which has been repeat recorded in accordance with the first embodiment of the present invention, in a preferred embodiment the recorder 16 is arranged in reverse so that the read/write heads operate to read information to detect the metadata packets and to distinguish and determine whether the same metadata packets have been recovered or whether these are different metadata packets. In this case the read/write control processor 36 would act as a read control processor. As will be appreciated the read/write control processor may not be aware of the rate at which the tape drive is driving the magnetic tape across the read/write heads 32. Therefore the control processor 36 operates to detect the header information of the metadata packets which are recovered successively in accordance with the order in which they were recorded. Therefore if in a group the read/write control processor 36 recovers a metadata packet and the next recovered metadata packet has the same header information, then the read/write control processor will discard the metadata packet having the same header information. If however the next metadata packet contains different header information then the read control processor will detect that the subsequently detected metadata packet is a different packet and that the metadata is different and therefore output the previous metadata packet along with the audio/video information signals recovered from the magnetic tape.

A further illustration of the method of recovering metadata, which has been recorded onto the magnetic tape in accordance with the first embodiment of the present

invention, is illustrated by a flow diagram shown in figure 9. In figure 9 the first process step 120 is to recover a metadata packet, with the next process step 122 being to recover the next metadata packet. At process step 124, the process determines whether the header information has changed between the last metadata packet and the previous metadata packet. If the header has not been changed then process step 126 is executed and the packet is discarded and the process continues from 122. If the header information has changed then the process step 128 is executed and the previous metadata packet is output. The process then continues from process step 122.

A second embodiment of the present invention will now be described in which the read/write control processor 36 operates to arrange the metadata and record the metadata repeatedly on the magnetic tape 34 in an arrangement which is represented by a table shown in figure 8. The representation shown in figure 8 is an illustration of an arrangement in which metadata is repeatedly recorded and does not represent the physical layout of metadata as recorded onto the magnetic tape 34. The representation provided in figure 8 is therefore a conceptual representation which facilitates understanding of one example of the second embodiment of the present invention. In accordance with the second embodiment of the present invention the read/write control processor 36 arranges the metadata objects into a plurality of categories. These metadata objects are then repeatedly recorded a number of times in dependence upon the relative importance of each of the categories. In the example embodiment shown in figure 8 there are four categories. In the first category represented by the first row of the table, the metadata objects are repeated eight times. Each of the cells of the table again represents an area of the magnetic tape where the USB-78 are recorded. As an example each cell may represent a byte of information. Therefore as shown in figure 8 if the word RED is considered to be of the highest importance then each of the letters which represents this example metadata object is repeatedly recorded eight times so that the first eight cells of the first row contain the letter "R". The next row of the table represents the next level of relative importance of the metadata. In this case the metadata objects are repeated four times. Therefore for example if the word GREEN is an example of metadata of this next level of relative importance, then each of the metadata objects which are the letters of the word GREEN are repeated four times

therefore the first four cells of the row contain the letter "G" whereas the next four cells of the row contain the letter "R". Similarly the next row of the matrix contains metadata of a correspondingly reduced level of importance. In this example the next level of metadata is represented by the word BLUE and in this row the metadata objects are repeated only twice. Therefore as shown in figure 8 the first two cells of this row contain the word "B" the next two cells contain the letter "L" and the next two cells contain the letter "U" and the final two cells contain the letter "E". Finally the final row of the table in figure 8 contains the least important metadata which is again represented by the date 01.11.99 13:28. These metadata objects are repeated only once. In operation the read/write control processor 36 begins writing new objects of metadata with reference to the time code derived from the frame clock 40 which is coupled to the write control processor 36.

A reproducing apparatus which operates to recover the metadata, which has been recorded onto the magnetic tape according to the second embodiment of the second invention, operates as follows. The reproducing apparatus may be the recorder 16 but operated in a reverse mode in that the tape drive is now reading information from the magnetic tape so that the read/write heads are now reversed so that they recover information recorded onto the magnetic tape. The read/write control processor 36 then operates as a read control processor. The control processor recovers each of the metadata objects and from an order or a position at which the metadata objects were recorded onto the magnetic tape 34 in the USB area 78, the read control processor is provided with an association of the recovered metadata objects with the categories in which they were recorded. This is provided with reference to the time-code, therefore time code provides an indication of the start of a new metadata group of objects recorded onto the magnetic tape 34. In this example embodiment, the reproducing apparatus will operate to detect a relative rate at which the information signals are being read from the magnetic tape 34 in accordance with a rate at which the magnetic tape 34 is being driven past the read/write heads 32 compared to the reading rate which is the speed at which the tape was driven when the information was being written onto and recorded onto the magnetic tape 34. Therefore by comparing the reading rate to the recording rate, the control processor 36 operates to calculate the number of

metadata objects which will be passed before the next metadata object can be recovered from the magnetic tape 34. By dividing this number by the number of times the metadata objects are repeated for each of the categories, the read control processor is able to determine whether the same object has been recovered from the magnetic tape and can therefore discard redundant metadata objects which have been recovered repeatedly. Consider the example shown in figure 8. In this case if the read speed is twice that of the recording rate, then of the first row which is repeated eight times, four of the objects will be recovered so that the read processor will have four "R"s. If however the reading rate is four times that of the recording rate, then the control processor will only have two "R"s. If the read rate is eight times the recording rate then only one "R" will be recovered. Similarly for the second row, if the reading rate is twice the recording rate then two "G"s will be recovered from the first four cells of this category. If however the reading rate is four times the recording rate then only one "G" will be recovered. If however the reading rate is times eight then the "G" will not be recovered. Correspondingly it will be appreciated that the number of times the metadata objects are repeated determines the likelihood of whether these objects may be recovered during playback at different shuttle reading rates.

A further understanding of the process of recovering metadata which has been recorded in accordance with the second embodiment of the present invention is provided by a flow diagram which is shown in figure 10. In figure 10 a first step in the process 130 is to recover the metadata objects from the USB areas 78. Necessarily, contemporaneously the time code is also recovered with the USB information, which is represented as a process step 131. At the next process step 132 the categories to which the metadata objects were assigned when they were recorded are determined. At the next process step 134 a rate at which the reading rate of the metadata is determined with respect to a reading rate which is the rate which the tape is being driven during reading mode. At process step 134 the relative rate of reading is calculated by dividing the reading rate by the recording rate. The next step 136 in the process, the pre-determined number of times the metadata objects were repeatedly recorded for each category is divided by the relative reading rate calculated in step 134. A result of step 136 is to generate a redundancy number which is fed to process step 138. At step 138

all metadata objects after one received following the first time code are discarded to a number equal to the redundancy number.

As will be appreciated the first embodiment of the present invention has an advantage in that the reproduction process for recovering the metadata is more efficient and more simple than the reproduction method required for the metadata recorded in accordance with the second embodiment of the present invention. However this advantage is gained at a disadvantage of requiring a redundant object to be added to the metadata packet which is the header information. In comparison the second embodiment of the present invention does not include any redundant objects although repeat recording in accordance with preferred embodiment is arranged with reference to the time code provided by the frame clock 40.

As will be appreciated by those skilled in the art various modifications may be made to the embodiments herein before described without departing from the scope of the present invention. Furthermore it will be appreciated that the methods of reproducing and recording as herein before described may be embodied and represented as instructions of a computer program. Furthermore the apparatus for recording and reproducing may form a suitably programmed data processor operating in accordance with instructions formed from a computer program.

CLAIMS

1. A recording apparatus which is arranged in operation to record audio and/or video information signals onto a linear recording medium, said apparatus comprising

- a recording drive arranged in operation to record said information signals onto said linear recording medium, and to record metadata associated with said information signals onto said linear recording media with said information signals, wherein said metadata is recorded repeatedly.

2. A recording apparatus as claimed in Claim 1, wherein said metadata comprises a plurality of objects, and said recording apparatus comprises

- a control processor coupled to said recording drive which is arranged in operation to

- determine a relative importance of the information represented by said metadata objects, and

- to configure said recording drive to record said metadata objects a number of times corresponding to said relative importance of said metadata.

3. A recording apparatus as claimed in Claim 2, wherein said recording drive is arranged in operation to record said information signals on to said linear recording medium at a recording rate, and the number of times said metadata objects are repeated is determined by said control processor from a combination of said relative importance and a reading rate at which said recorded information signals may be read from said linear recording medium.

4. A recording apparatus as claimed in any preceding Claims, wherein said number of times said metadata objects are repeated is determined by said control processor from said relative importance and a number of times said reading rate is greater than said recording rate.

5. A recording apparatus as claimed in any preceding Claim, wherein said information signals and said metadata are recorded by said recording drive on to said linear recording medium whereby said information signals and said metadata may be separated when read from said linear recording medium.

6. A recording apparatus as claimed in any preceding Claim, wherein said control processor is arranged in operation to assign each of said metadata objects to one of a plurality of categories of relative importance, the number of times the metadata objects are repeat recorded being pre-determined for each of said categories.

7. A recording apparatus as claimed in Claim 6, wherein for each of said categories of relative importance the control processor is arranged in operation to

- record the same allocated metadata object in each of a plurality of adjacent cells of said recording medium for said predetermined number of times, and
- record a subsequent metadata object allocated to the same category for said predetermined number of times in a subsequent plurality of adjacent cells.

8. A recording apparatus as claimed in Claim 7, wherein the same metadata object is recorded with reference to a temporal marker recorded with said information signals and said metadata.

9. A recording apparatus as claimed in Claim 8, wherein the temporal marker is a time code recorded with said information signals.

10. A recording apparatus as claimed in any of Claims 7 to 9, wherein said plurality of adjacent cells associated with the same category are recorded along a linear axis of the recording medium.

11. A recording apparatus as claimed in any of Claims 2 to 5, wherein the control processor is arranged in operation to

- form metadata packets having a plurality of fields, and

- control said recording drive to record said metadata packets on to said linear recording medium, whereby said metadata objects are repeated said pre-determined number of times.

12. A recording apparatus as claimed in Claim 11, wherein said control processor further operates to

- allocate the metadata objects to the fields of the packets, whereby the metadata object is repeated in the fields of at least one of said packets.

13. A recording apparatus as claimed in Claim 11, wherein the control processor is arranged in operation to

- allocate a different metadata object to each field of the packet, and
- record repeatedly said metadata packet said determined number of times.

14. A recording apparatus as claimed in any of Claims 11 to 13, wherein the control processor is arranged in operation to

- provide each of said metadata packets with a header field, and
- allocate header information to said header field, which header information is indicative of the metadata objects within the fields of the packet.

15. A recording apparatus as claimed in Claim 14, wherein the control processor is arranged in operation to change the header information between successive packets recorded onto the linear recording medium which have at least one different metadata object.

16. A recording apparatus as claimed in any preceding claim, wherein said linear recording medium is a magnetic tape, and the recording drive has

- a rotating head which is configured in operation to record said information signals in helical scan tracks disposed at an angle to a linear axis of said recording tape, and

- a linear recording head which is configured in operation to record said metadata in linear tracks of said magnetic tape at a position adjacent to said helical scan tracks.

17. A recording apparatus as claimed in Claim 16, wherein said metadata is recorded in said linear tracks allocated as user specified bits with said time code.

18. A reproducing apparatus which is arranged in operation to recover audio and/or video information signals recorded with metadata associated with the information signals on to a linear recording medium using a recording apparatus claimed in any preceding Claim, said reproducing apparatus comprising

- reading drive which operates to recover the information signals from the linear recording medium, and the metadata from the linear recording medium, and

- a read control processor which is arranged in operation to determine whether the same metadata has been read by the reading drive from the linear recording medium, to discard the metadata which has been read more than once, and to reproduce said information signals with said metadata.

19. A reproducing apparatus as claimed in Claim 18, when dependent on Claims 6 to 10, wherein the read control processor is configured in operation

- to determine an amount by which the reading rate is greater than the rate at which said information signals were recorded,

- to determine which of the categories of relative importance the metadata objects read from said linear receding medium were assigned when recorded,

- to determine the number of times metadata objects in each category have been repeatedly recorded,

- to calculate a number of said metadata objects which will be the same metadata object read from said category in dependence upon said amount by which said reading rate is greater than said recorded rate and the pre-determined number of times the metadata objects have been repeatedly recorded in the category, and

- to select one of the metadata objects from the calculated number of metadata objects read with reference to the temporal marker which are the same.

20. A reproducing apparatus claimed in Claim 19, when dependent upon Claims 11 to 17, wherein the reading drive is arranged in operation to read each of said metadata packets successively from said linear recording medium, and the read control processor is arranged in operation

- to recover from the packet header of each packet said header information,

- to determine from said successive packets whether the corresponding header information has changed from one packet to a subsequent packet,

- to determine an amount by which the reading rate is greater than the rate at which said information signals were recorded,

- to determine whether more than one packet has the same header,

- to calculate a number of said metadata packets read from said recording medium which will be the same since said header information has changed in dependence upon said determined amount by which said reading rate is greater than said recorded rate, and

- to select one of the metadata packets from the calculated number of metadata packets read which are the same.

21. A recording/reproducing apparatus having a recording apparatus as claimed in any of Claims 1 to 17, and a reproducing apparatus as claimed in any of Claims 18 to 20, wherein said recording drive and said reading drive are formed as a recording/reading drive, and said control processor and said reading control processor are formed as a reading/reproducing processor.

22. A video recorder having a recording/reproducing apparatus as claimed in Claim 21.

23. A method of recording audio and/or video information signals onto a linear recording medium, comprising the steps of

- recording said information signals onto said linear recording medium,

- recording metadata associated with said information signals onto said linear recording medium with said information signals, wherein said metadata is recorded repeatedly.

24. A method as claimed in Claim 23, wherein said metadata comprises a plurality of objects, and the step of recording said metadata comprises the steps of

- determining a relative importance of the information represented by said data objects, and

- repeating the recording of said data objects a number of times corresponding to said relative importance of said metadata.

25. A method as claimed in Claim 24, wherein the step of recording said information signals comprises recording said information signals on to said linear recording medium at a recording rate, and the number of times said metadata is repeated is determined in accordance with a combination of said relative importance and a number of times a rate of reading said information signals exceeds the recording rate.

26. A method as claimed in any of Claims 23 to 25, wherein the step of recording said metadata on to said linear recording medium comprises recording said metadata on to said recording medium whereby said metadata may be separated from said information signals when read from said recording medium.

27. A method as claimed in any of Claims 23 to 26, wherein each of said metadata objects are assigned to one of a plurality of categories of relative importance, and the step of repeat recording said metadata objects comprises the steps of

- allocating each of said metadata objects to one of said categories of relative importance, and

- repeat recording said metadata objects in accordance with the allocated category, the number of times the metadata object is repeat recorded being pre-determined for said category.

28. A method as claimed in Claim 27, wherein the step of repeat recording said metadata objects in accordance with said allocated categories comprises the steps of

- for each of said categories of relative importance recording the same allocated metadata object in each of a plurality of adjacent cells of said recording medium for said predetermined number of times, and

- recording a subsequent metadata object allocated to the same category for said predetermined number of times in a corresponding plurality of adjacent cells.

29. A method as claimed in Claim 28, wherein the same metadata object is recorded with reference to a temporal marker recorded with said information signals and said metadata.

30. A method as claimed in Claim 29, wherein said temporal marker is a time code recorded with said information signals.

31. A method as claimed in either of Claims 27 or 30, wherein said plurality of adjacent cells associated with the same category are recorded along a linear axis of the recording medium.

32. A method as claimed in any of Claims 23 to 31, wherein the step of repeat recording said metadata objects comprises the steps of

- forming metadata packets having a plurality of fields,

- allocating the metadata objects to the fields of at least one of the packets, whereby the metadata object is repeated in the fields of the at least one packet said determined number of times, and

- recording said at least one metadata packet.

33. A method as claimed in Claim 32, wherein the step of allocating the metadata objects to the fields of said at least one packet comprises the steps of

- allocating a different metadata object to each field of the packet, and

the step of recording the at least one metadata packet comprises the step of

- recording repeatedly said metadata packet said determined number of times.

34. A method as claimed in Claims 32 or 33, wherein the step of forming said metadata packet comprises the steps of

- providing each of said metadata packets with a header field, and

- allocating header information to said header field, which header information is indicative of the metadata objects within the fields of the packet.

35. A method as claimed in Claim 34, wherein the header information changes between successive packets recorded onto the linear recording medium which have different metadata objects.

36. A method as claimed in any preceding claim, wherein said linear recording medium is a magnetic tape, and the step of recording said information signals comprises the steps of

- recording said information signals using a rotating head whereby said information signals are recorded in helical scan tracks disposed at an angle to a linear axis of said recording tape, and the step of recording said metadata comprises the step of

- recording the metadata using a linear recording head along said linear tracks of said magnetic tape at a position adjacent to said helical scan tracks.

37. A method as claimed in Claim 36, wherein said position adjacent to said linear tracks is the position allocated to said user specified bits and with said time code.

38. A method of reproducing information signals recorded with metadata associated with the information signals on to a linear recording medium using the method of recording claimed in any of Claims 23 to 37, comprising the steps of

- reading the information signals from the linear recording medium,
- reading the metadata from the linear recording medium,
- determining whether the same metadata has been read from the linear recording medium during the step of reading the metadata,
- discarding the metadata which has been read more than once, and
- reproducing said information signals with said metadata.

39. A method of reproducing as claimed in Claim 38, when dependent on Claims 27 to 31, wherein the step of reading the metadata comprises the steps of

- determining an amount by which the reading rate is greater than the rate at which said information signals were recorded,
- determining which of the categories of relative importance the metadata objects read from said linear recording medium were assigned when recorded,
- determining the number of times metadata objects in the category has been repeatedly recorded,
- calculating a number of said metadata objects which will be the same metadata object read from said category after the temporal marker in dependence upon said determined amount by which said reading speed is greater than said recorded rate and the pre-determined number of times the metadata objects have been repeatedly recorded in the category, and the step of selecting and discarding the metadata comprises
- selecting one of the metadata objects from the calculated number of metadata objects read which are the same.

40. A method of reproducing information signals as claimed in Claim 38, when dependent upon Claims 32 to 37, wherein the step of reading the metadata comprises the steps of

- reading each of said metadata packets successively from said linear recording medium, and

- recovering from the packet header of each packet said header information, and

- determining from said successive packets whether the corresponding header information has changed from one packet to a subsequent packet, and the step of determining whether the same metadata object has been read more than once from the recording medium comprises,

- determining an amount by which the reading rate is greater than the rate at which said information signals were recorded,

- determining whether more than one packet has the same header,

- calculating a number of said metadata packets read from said recording medium which will be the same since said header information has changed in dependence upon said determined amount by which said reading speed is greater than said recorded rate, and the step of discarding the metadata comprises

- selecting one of the metadata packets from the calculated number of metadata packets read which are the same.

41. A computer program providing computer executable instructions, which when loaded onto a computer configures the computer to operate as a recording apparatus as claimed in any of Claims 1 to 20.

42. A computer program providing computer executable instructions, which when loaded on to a computer causes the computer to perform the method according to Claims 23 to 40.

43. A computer program product having a computer readable medium recorded thereon information signals representative of the computer program claimed in any of Claims 41 or 42.

44. A recording apparatus as herein before described with reference to the accompanying drawings.

45. A reproducing apparatus as herein before described with reference to the accompanying drawings.

46. A method of recording audio and/or video information signals as herein before described with reference to the accompanying drawings.

47. A method of reproducing audio and/or video information signals as herein before described with reference to the accompanying drawings.

ABSTRACT

RECORDING/REPRODUCING APPARATUS AND METHOD FOR RECORDING/REPRODUCING INFORMATION SIGNALS

A recording apparatus is arranged in operation to record audio and/or video information signals onto a linear recording medium. The recording apparatus comprises a recording drive arranged in operation to record the information signals onto the linear recording medium, and to record metadata associated with the information signals onto the linear recording media with the information signals, wherein the metadata is recorded repeatedly. The metadata may comprise a plurality of objects, and the recording apparatus may comprise a control processor coupled to the recording drive which is arranged in operation to determine a relative importance of the information represented by the metadata objects, and to configure the recording drive to record the metadata objects a number of times corresponding to the relative importance of said metadata.

Fig. 2

1/5

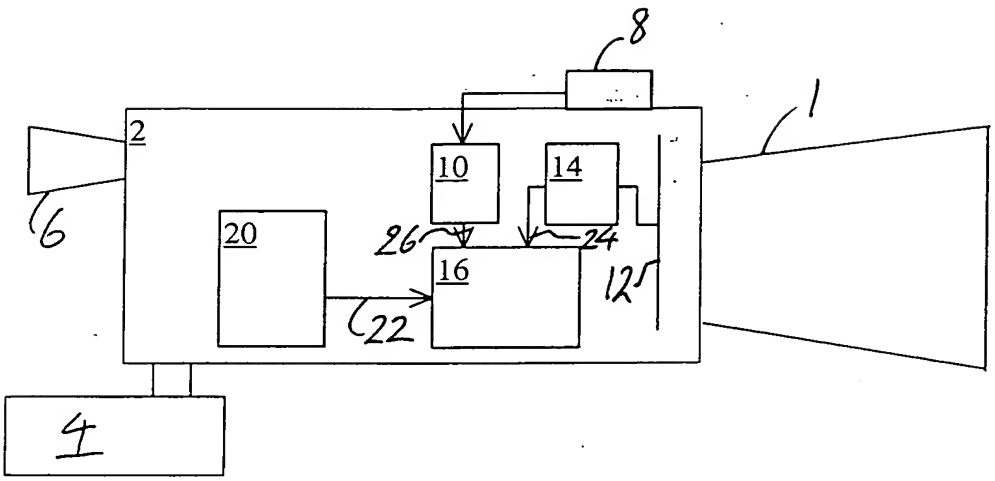
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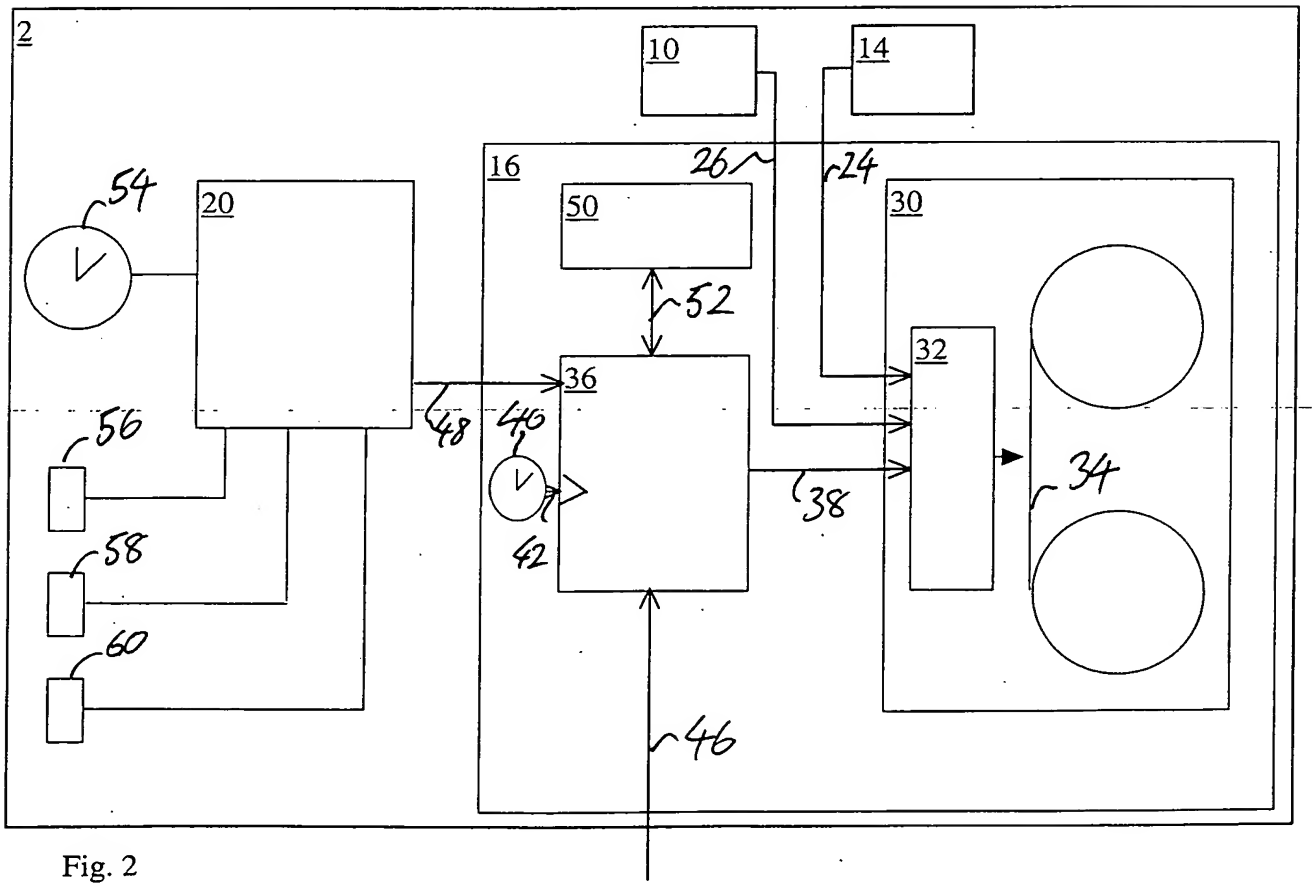
Fig. 1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42
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Fig. 2

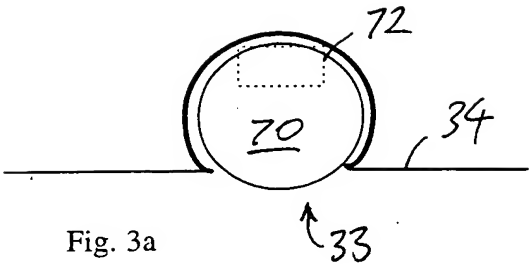

Fig. 3a

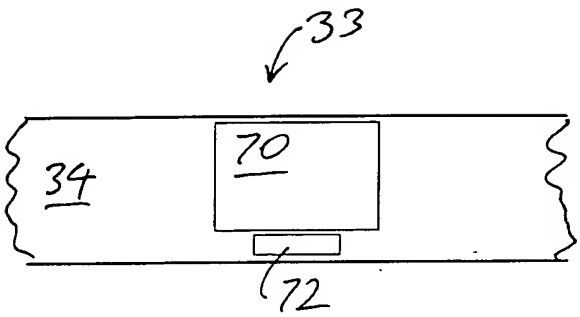

Fig. 3b

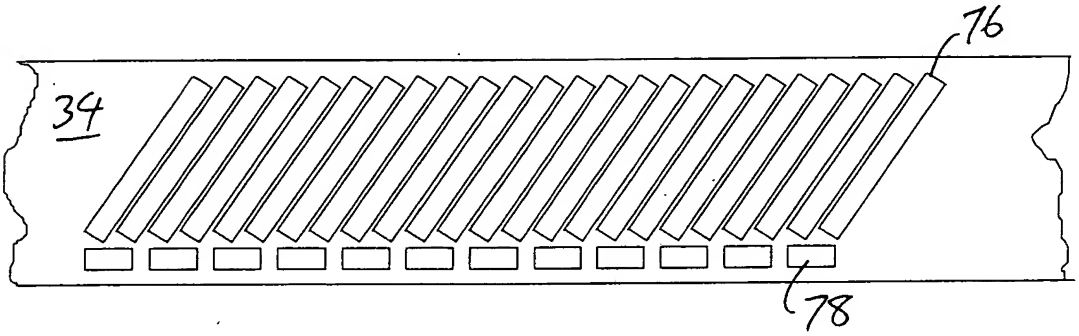

Fig. 4

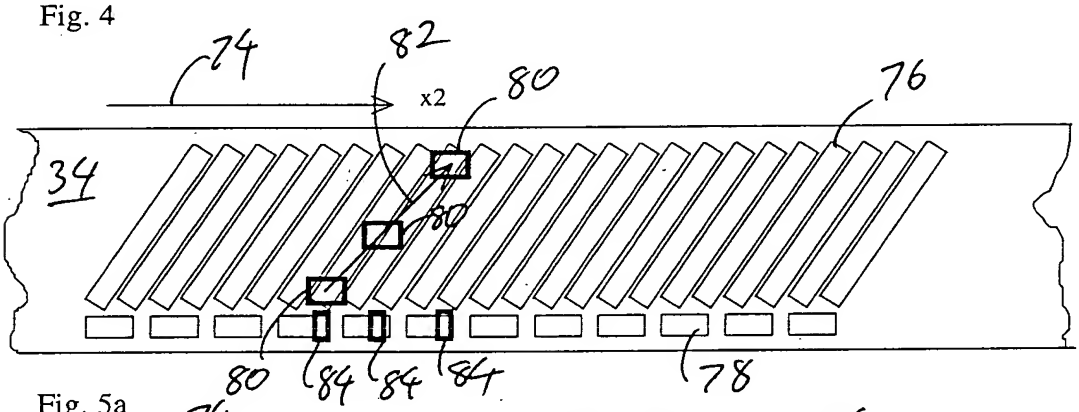

Fig. 5a

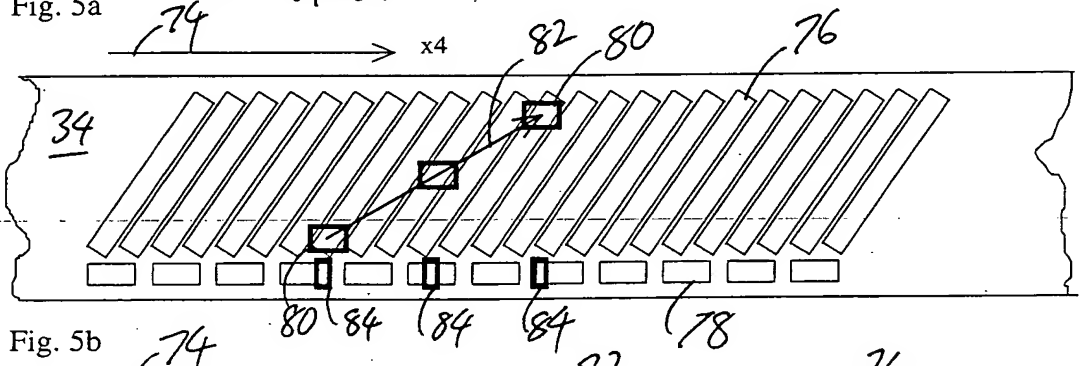

Fig. 5b

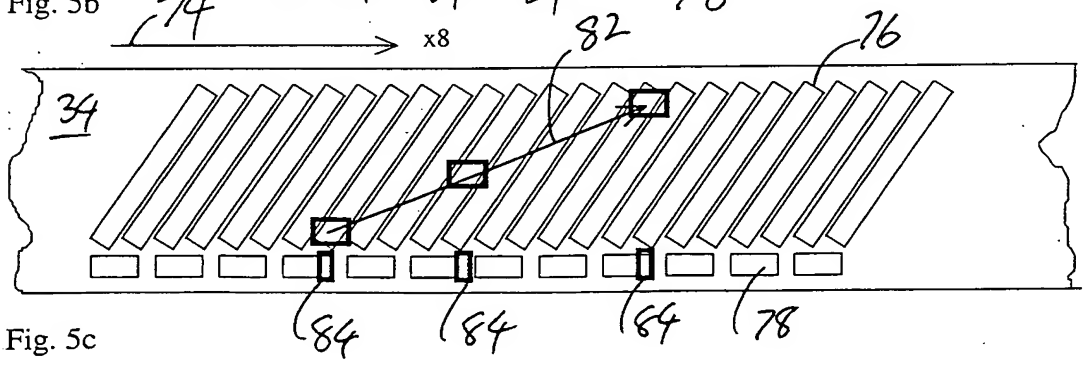

Fig. 5c

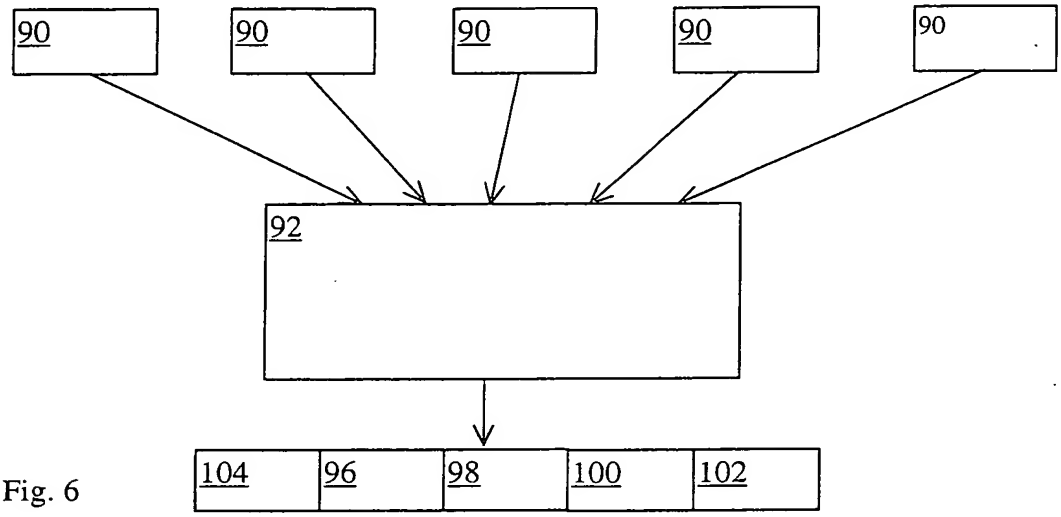

Fig. 6

94 94 94 94 94

0	0	0	0	1	1	1	1	2	2	2	2	0	1	2	3
R	R	R	R	G	G	G	G	E	E	E	E	0	1	1	8
E	E	E	E	R	R	R	R	N	N	N	N	1	9	3	--
D	D	D	D	E	E	E	E	--	--	--	--	1	9	2	--

104 106 108 110

Fig. 7

X8	R	R	R	R	R	R	R	R	E	E	E	E	E	E	E	E
X4	G	G	G	G	R	R	R	R	E	E	E	E	E	E	E	E
X2	B	B	L	L	U	U	E	E								
X1	0	1	1	1	9	9	1	3	2	8						

TC TC

Fig.8

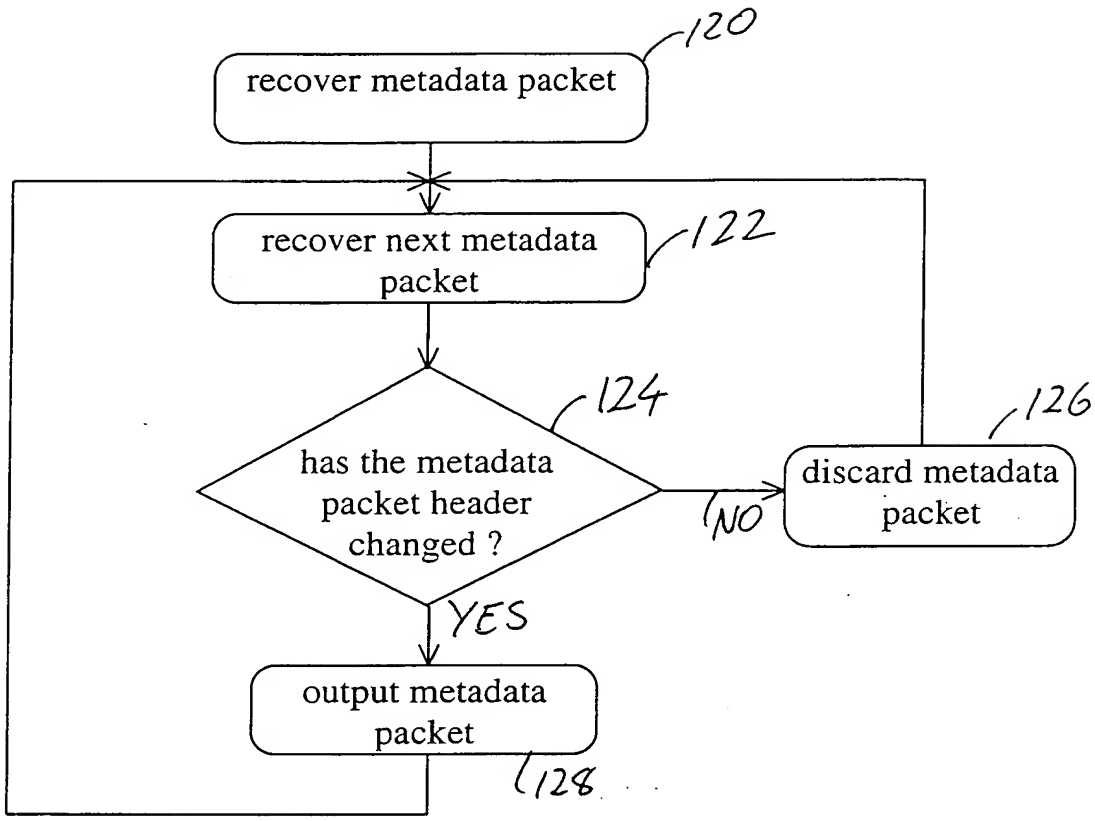
recover metadata packet
120
recover next metadata packet
122
has the metadata packet header changed ?
124
NO
discard metadata packet
126
YES
output metadata packet
128

Fig. 9

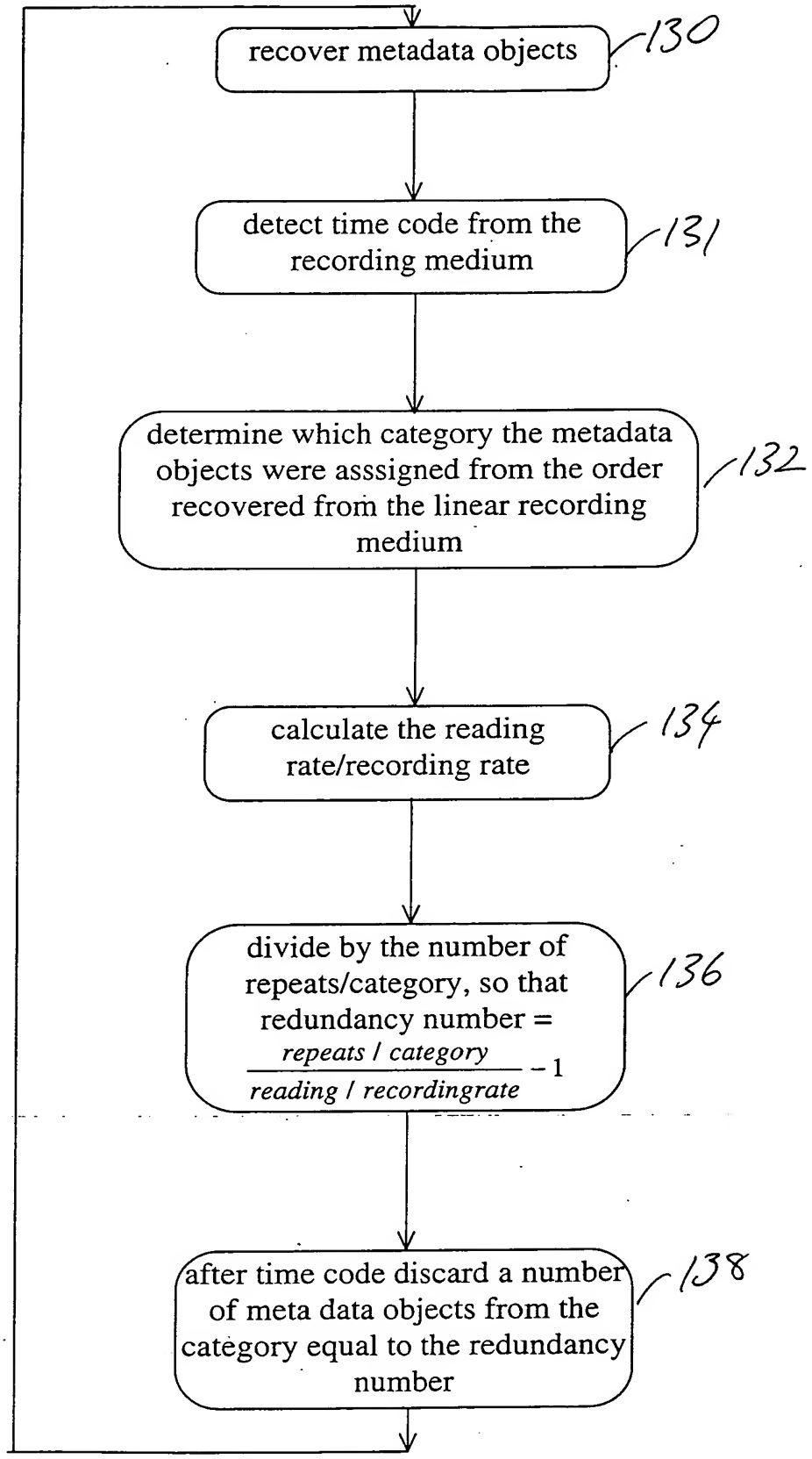
recover metadata objects
130
detect time code from the recording medium
131
determine which category the metadata objects were asssigned from the order recovered from the linear recording medium
132
calculate the reading rate/recording rate
134
divide by the number of repeats/category, so that redundancy number = repeats / category / reading / recordingrate − 1
136
after time code discard a number of meta data objects from the category equal to the redundancy number
138

Fig. 10